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# Benefits of Web-based Construction Management in Naval Facilities Engineering Command

by

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**Benefits of Web-based Construction Management in Naval Facilities Engineering Command**

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**Aaron Turke**

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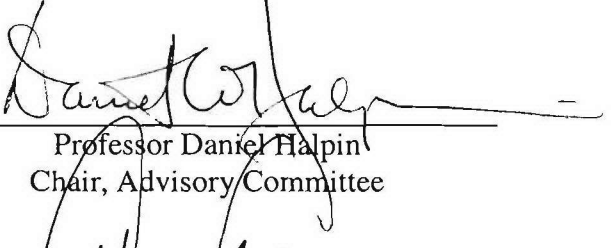

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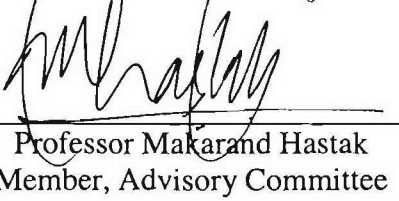

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# ABSTRACT

One of the most critical stages in introducing a new business technology is the implementation. At this stage the employees that are charged with using the new technology must relinquish the way of doing business they have been performing for some time. The employees more than likely have a certain comfort in the old way of doing business and will be reluctant to radical change. This is especially the case in the construction industry which is more reluctant in implementing technological advancements than most other industries due to historical and cultural reasons.

Naval Facilities Engineering Command is currently at the critical stage of implementation of their web-based construction management tool called WebCM. This paper is written to support WebCM implementation by describing the potential benefits and making implementation and technological suggestions based on similar endeavors in the private sector. By highlighting the potential benefits, the validity and importance of the system should become clearer to the construction contractors, administrators, and clients that will use the system. The suggestions are for the WebCM promoters to consider during the implementation phase and into the future.

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# 1 INTRODUCTION

## *1.1 Purpose Statement*

The purpose of this report is to support and assist the implementation of a web-based construction management (WebCM) system that is currently being implemented throughout Naval Facilities Engineering Command (NAVFAC). NAVFAC introduced WebCM to its employees and contractors in September of 2003. WebCM was first implemented on a few high visibility projects and now is being introduced to all of the field offices within the NAVFAC organization on select projects. When fully implemented, every project over $500,000 in value will be managed with the assistance of WebCM.

Communicating the benefits to the eventual users and borrowing suggestions from private industry will positively influence the adoption of the technology by the users which is the ultimate goal of the implementation stage. Through review of the NAVFAC organization and acquisition process, administrative requirements of a NAVFAC contract, and capabilities of the implemented system it is possible to clearly explain the potential benefits of this technology. Currently the system is in its infancy and the benefits can only be proposed qualitatively. However, defining these benefits can assist in the adoption of the technology by the employees of NAVFAC and its contractors. Further, improvements for the current or future versions of the system are suggested based on reviews of case studies performed in the private sector.

## 1.2 Problem Statement

Around 80% of disruptions in construction projects are caused by discrepancies in planning, poor communication, and incorrect decisions. (Erlach, 2002) NAVFAC's WebCM has the potential to reduce the probability of occurrence of all these causes. However, even the most robust and efficient web-based construction management tools are not effective if not adopted by the project personnel. Historically the construction industry as a whole has not been quick to adopt the use of information technology in day-to-day business processes (Mohamed and Stewart, 2003). NAVFAC WebCM is at its most critical stage, implementation. The extent to which NAVFAC is able to foster adoption of the technology amongst its employees and contractors singularly holds the success or failure of WebCM and possibly future information technology advancements across the organization.

## 1.3 Reader's Guide

I suggest the readers that have a basic knowledge of the NAVFAC organization and the acquisition process only scan sections three and four. Further, individuals that have participated in NAVFAC construction contract administration need only scan section five. These sections introduce the reader to the NAVFAC organization, contract process, and contract administrative requirements in order to fully understand the potential benefits of WebCM.

Section two provides background information regarding web-based construction management. A history of the technology is provided along with the

general purpose and structure of a generic system. This section will be helpful to those that don't know what web-based construction management is or the fundamentals of how such a system operates.

Section six takes a comprehensive look at both the history of NAVFAC's WebCM and how it exists today. The section focuses on a description of the system with respect to the WebCM requirements of the service and the contractors, the user interface, and the system capabilities. Section seven takes into consideration all of the information in the previous sections and qualitatively suggest potential benefits of the system. Also this section proposes possible improvements to the system and its implementation.

The report is finalized with a brief conclusion in section eight followed by two appendices. Appendix A is a list of the references used in writing this report and Appendix B is a copy of the WebCM contract specification.

# 2 WEB-BASED CONSTRUCTION MANAGEMENT

Web-based construction management can be defined as any web-based technologies that allow the members of a construction team to collaborate, access documents, and alter documents by way of the internet. These technologies are known by many names and acronyms such as: Construction Project Extranets (CPE), Web-based Project Management (WebPM), electronic Project Management (ePM), and Web-based Construction Management (WebCM). All of these terms describe the same technology; the history, purpose and structure of which will be discussed in this section.

## *2.1 WebCM History*

### 2.1.1 Technology Background

The history of WebCM is largely dependent on the advancements made in both information technology and the internet. The history of information technology can be traced all the way back to the advent of a formal written language devised by the Sumerians around 3000 B.C. (A History of Information Technology and Systems, 1998) This first made it possible for people to communicate through standard written characters and create more permanent documentation. Today almost everything is documented, especially in the business world, and there is an evolution away from physical documentation to digital documents created and stored on computers.

The internet on the other hand is a much more contemporary development. The basics of the technology were first explored in 1968 when the Advanced Research Projects Agency (ARPA) initiated ARPANET. The aim of the project was to allow networked computers to communicate across linked packet networks. The project was awarded to Bolt Beranek and Newman Inc., and in 1969 the first nodes or hosts were established at UCLA, UCSB, Stanford, and the University of Utah. The term "Internet" was established in 1973 by a project called the Internetting Project, and the system of networks that were developed were called the Internet. (History and Development of the Internet, 2000) Since these beginnings, many internet backbone networks have been established by public and private entities for both public and private use. The Internet has developed into a fixture for communication and commerce in the personal and business lives of nearly all people of industrialized nations.

Before the manifestation of the internet as an information transfer platform businesses focused on information management within a single organization or a single location. The internet allows companies to apply information technology solutions across different locations within their own organization as well as allowing them to collaborate with outside organizations and institutions. The continual improvement in the speed and security of the internet along with the general acceptance by society is allowing the internet to be utilized in ever more complex and secure applications, web-based construction management being one of those applications.

### 2.1.2 WebCM Hype Cycle

The history of the development and implementation of WebCM can best be described by the "Hype Cycle of Technology." The idea of the hype cycle was introduced by Jackie Fenn of the Gartner Group in 1995. "A Hype Cycle is a graphic representation of the maturity, adoption, and business application of specific technologies." The Hype Cycle is a five phase process through which most technological innovations pass. The Hype Cycle of Technology is shown below in Figure 1.

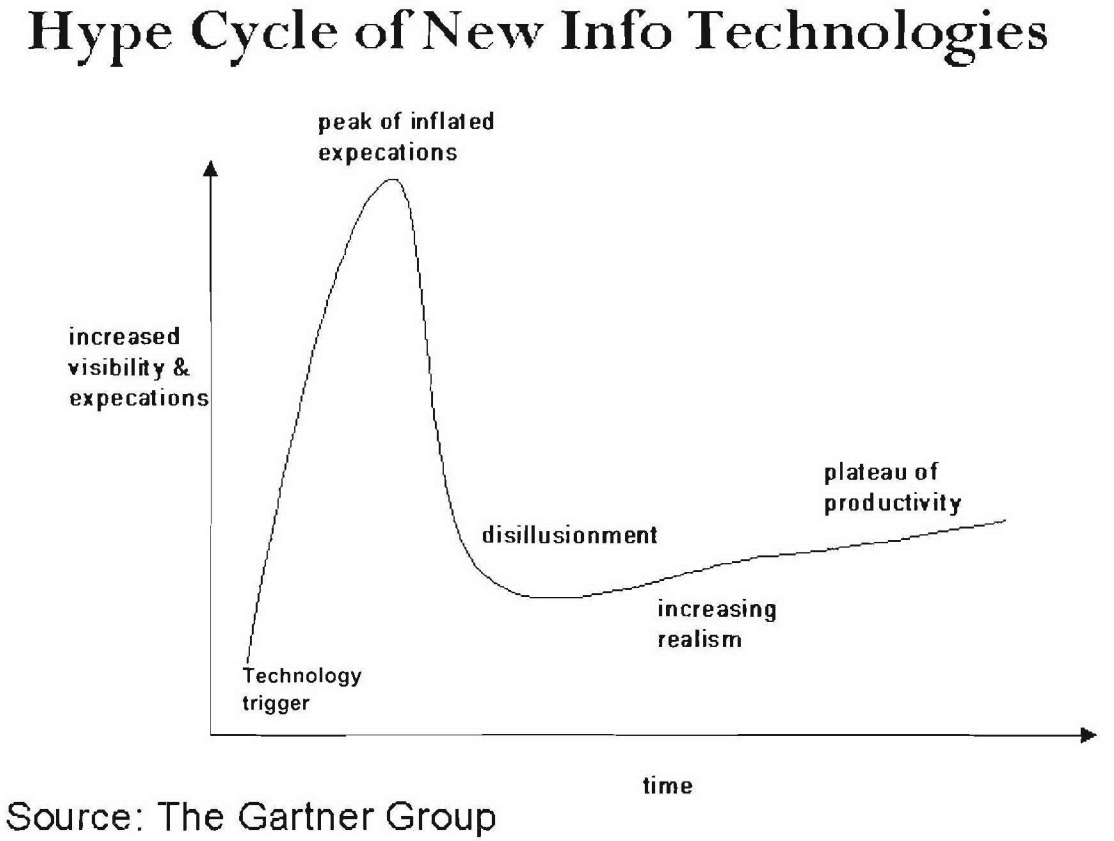


**Figure 1: Information Technology Hype Cycle**

#### 2.1.2.1 Technology Trigger

The technology trigger for web-based construction management occurred in 1995. In this year a number of pioneers in the field launched their first attempts at offering internet technology to improve project management methods. A few of the original offerings were introduced by e-Builder, Collaborative Structures, and Framework Technologies.

#### 2.1.2.2 Peak of Inflated Expectations

The next four years showed a steady increase in the number of companies offering such products and the number of products offered by each company. From 1996 to 1999 more than 80 start-up companies were formed that offered web-based management tools. (Becerik, 2004) The design and construction industries both realized the potential of these tools to benefit their organizations and the execution of projects. The expectations finally peaked in 2000 with the establishment of even more start-ups and a flurry of mergers and acquisitions. A couple of the major developments at this time was the introduction of PrimeContract by well established Primavera Systems Inc. and the acquisition of Cubus by Bidcom followed by the merger with Cephren to form Citadon. (Becerik, 2004) This peak in the WebCM cycle closely correlates with the "dotcom" boom of the same period.

#### 2.1.2.3 Trough of Disillusionment

The peak in 2000 was followed by a steep decline down to what is known as the trough of disillusionment. A major cause of this was the corresponding implosion of the "dotcom bubble." At this time support for the start-up companies from venture capitalists dried up and many were forced to go out of business. The design and construction firms that were experimenting with the new tools were dissatisfied and many lost all of the information for projects that were managed on the products supplied by the companies that went under. The companies introducing products during the preceding boom were focused on gaining market share rather than focusing on the functionality of the product and what the design and construction industry was looking for.

#### 2.1.2.4 Slope of Enlightenment

This is the phase of the cycle in which the WebCM industry is at the time of this writing. The companies that survived the disillusionment have learned from their own mistakes and the mistakes of others. Currently there are 111 companies that provide this service to the design and construction industry in the US market. (Extranet News, 2003) They are offering products in their second and third versions with vast improvements from the original offerings. Innovators in the design and construction industry still have a vision of the potential of the technology and the companies that provide the products are working to provide products that realize this vision. The number of organizations that have successfully implemented the technology is increasing which is bringing a light to some of the benefits that WebCM can provide.

#### 2.1.2.5 Plateau of Productivity

This phase of the cycle occurs when the technology demonstrates its benefits and they become widely accepted. Inevitably WebCM technology will reach this state, but that height of the plateau is unclear. This will be determined by how broad of a market will accept the technology and the level of measurable benefits that can be obtained.

## *2.2 WebCM Purpose*

The purpose of WebCM, simply put, is to aid in the effective management of a construction project by providing web-enabled project management functions. Different WebCM applications may be geared towards certain phases of the construction, but they all attempt to serve as a platform for communication, collaboration, and information management to aid in project management.

A construction project is a complex activity that involves a large number of parties such as the owner (developer), architects/engineers, construction consultants, and contractors working together on different aspects of construction processes. Cooperation and dialogue between them has a major impact on the successful performance end efficiency of the team, on which the success of the construction project is so dependent. Daily there are numerous information exchanges between project managers, contractors, and designers in the form of letters, contract bids, progress reports, and other document submissions. Along with the actual documents, a significant amount of filing and bookkeeping is required in their processing.

All the team members involved with the construction process are confronted with issues of responding to the daily requests on project related matters. Any neglect and unsystematic organization of the incoming information may create conflicts and cause delays caused by miscommunication. Instant communication and fast flow of information plays a critical role in effective project control. All WebCM applications are designed to provide a conduit to accelerate communication and information flow as well as providing an organized information management structure.

## *2.3 WebCM Structure*

The structure of WebCM applications, like the purpose, differs depending on the service provider, but there is a general framework that can describe all of them. An understanding of the basic structure of such a system aids in comprehending how the purpose of WebCM is realized and the potential benefits it can provide.

The system has three basic parties: Project Managers (project owner and/or developer), member companies (consultants and contractors), and service providers. The requirement of information transfer between these entities defines the parameters for the structure of the system. A schematic representation of a WebCM structure is given in Figure 2.

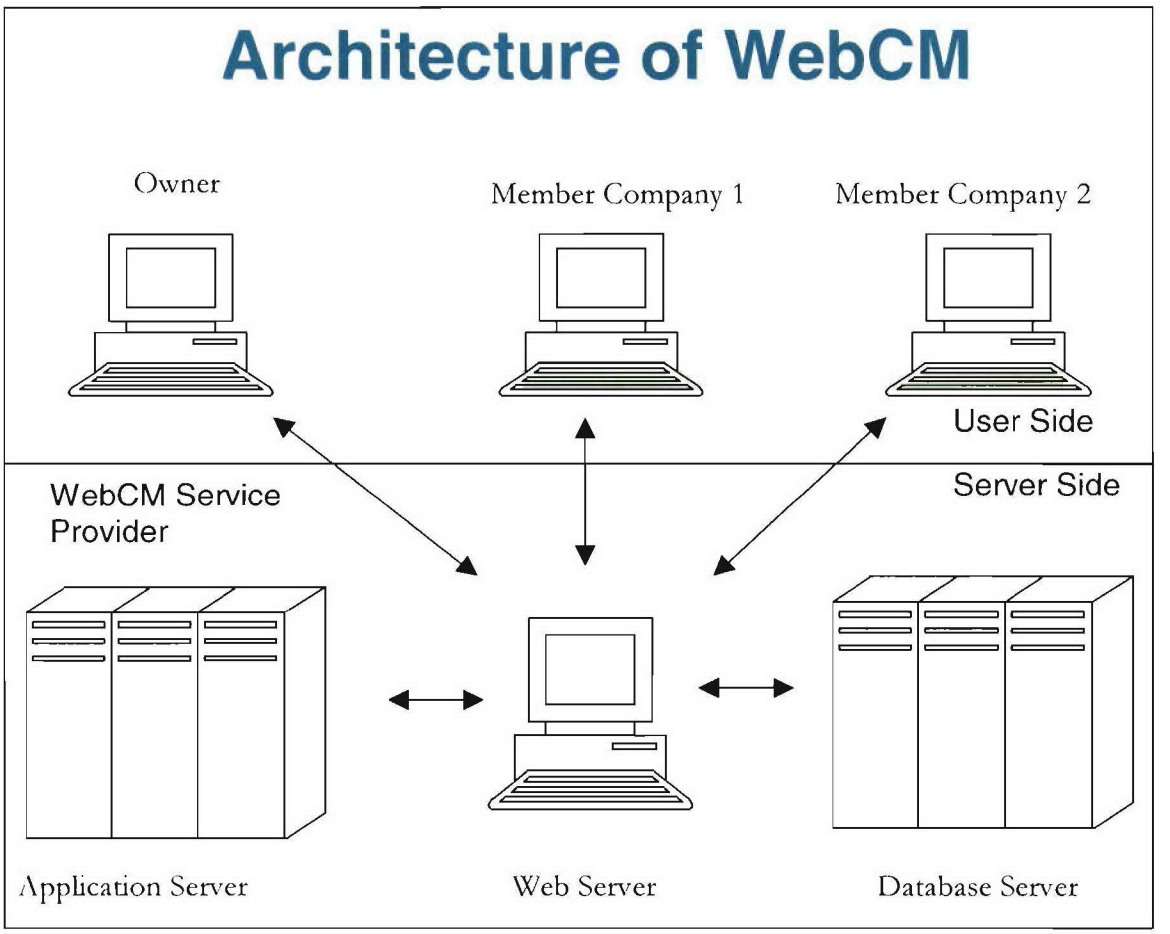


**Figure 2: WebCM basic hardware structure**

The service provider of the WebCM system provides three types of services: web, database, and application services. The web service is a key element of the proposed system and it generally consists of three areas: public, member and manager areas (Lam and Chang 2002). The access to the member areas and to the manager area is controlled by user names and passwords. The different areas provide for different levels of access and authority for viewing and editing documents.

The web service provides the interface through which the member companies access information, create or edit documents, and collaborate with

one another. The actual content of the web pages differs from application to application but the services offered are similar.

The database server is another critical element of the system. The database server can be thought of as the "project hard drive." A personal computer has a hard drive where the personal documents of its owner are stored; similarly all the documents of the project are stored on the database server. Access to the documents is made available to the member companies only through the web interface. The location of where documents are stored controls the access to those documents. Document access can be limited with regard to level of access (i.e. public, member, manager) or limited to one or more member organizations. Security of the server and the information stored upon it are paramount considering the importance of project information.

The application server stores and makes available to users any software that is required to view or create documents used in the project. This service is especially useful for projects using proprietary software created by the service provider, owner, or contractor. Today most documents are generated and viewed with software applications that are considered to be standard assumed to be available on the computers of all member organizations. As a result, the application server may only be used for specialty software (i.e. schedules, drawings.)

## *2.4 WebCM Summary*

The idea of using web-based technology to aid in the management of construction projects has only been around for about 10 years. Throughout its

history the purpose has remain unchanged; to serve as a platform for communication, collaboration, and information management to aid in project management. The early attempts at applying this technology proved relatively unsuccessful due to the fact many of the companies supplying the service were focused largely on gaining market share rather than satisfying the needs of the users. The initial boom in expectations and service providers has passed and many lessons were learned in the failures and successes. Today there stands a relatively standard model for the structure of these systems and an increasing number of businesses and organizations are utilizing the technology successfully.

# 3 NAVAL FACILITIES ENGINEERING COMMAND

A brief discussion of the purpose and organization of Naval Facilities Engineering Command (NAVFAC) is necessary in order to understand the influences that are present in the construction process and the possible benefits of using web-based construction management. WebCM must enhance the services that NAVFAC provides to the Navy and the Department of Defense and dovetail with the organization and systems already in place. This section details the current role of NAVFAC within the Navy and how NAVFAC is structured in order to fill that role.

## *3.1 NAVFAC Overview*

"NAVFAC manages the planning, design and construction of shore facilities for U.S. Navy activities around the world." (NAVFAC "NAVFAC Facts", 2004) NAVFAC's history traces all the way back to 1842 and the formation of the Bureau of Navy Yards and Docks (BUDOCKS). At that time the entire staff of BUDOCKS consisted of six individuals. The Bureau grew steadily as the Navy commissioned more ships and more shore infrastructure was needed. By World War I BUDOCKS had grown to a total of just under 1,000 employees and reached its largest size during World War II with just under 12,000 employees. A major restructuring of the Navy in 1966 changed the name of BUDOCKS to the Naval Facilities Engineering Command. The structure and mission of NAVFAC has been continually changing since its inception as BUDOCKS. (NAVSCOLCECOFF, 2001)

Today NAVFAC employs 16,000 civilian and military personnel and has an annual volume of business in excess of $8 billion. To put this in perspective, the 2003 revenues of Bechtel Corporation and Flour Corporation, the two largest American construction companies, were $16.3 billion and $8.8 billion respectively. (Bechtel, 2004 and Flour, 2004) The responsibilities of NAVFAC today include the following:

- Base Development, Planning, and Design
- Military Construction
- Public Works
- Utilities & Energy Services
- Base Realignment and Closure
- Environmental Programs
- Weight Handling
- Military Operations and Contingency Engineering
- Acquisition
- Real Estate
- Family & Bachelor Housing
- Ocean Engineering
- Transportation Planning & Management

**Figure 3: Responsibilities of NAVFAC today**

The highlighted responsibilities are the areas where the majority of traditional contracted construction takes place, and hence where WebCM will primarily be employed.

## *3.2 NAVFAC Organization*

NAVFAC accomplishes its mission through its headquarters located in Washington DC and a worldwide organization of field components. This discussion of the organization will focus on the field components that provide engineering support and administration of construction, alteration, and repair of the Navy shore establishment. The organization of NAVFAC is shown in Figure 4.

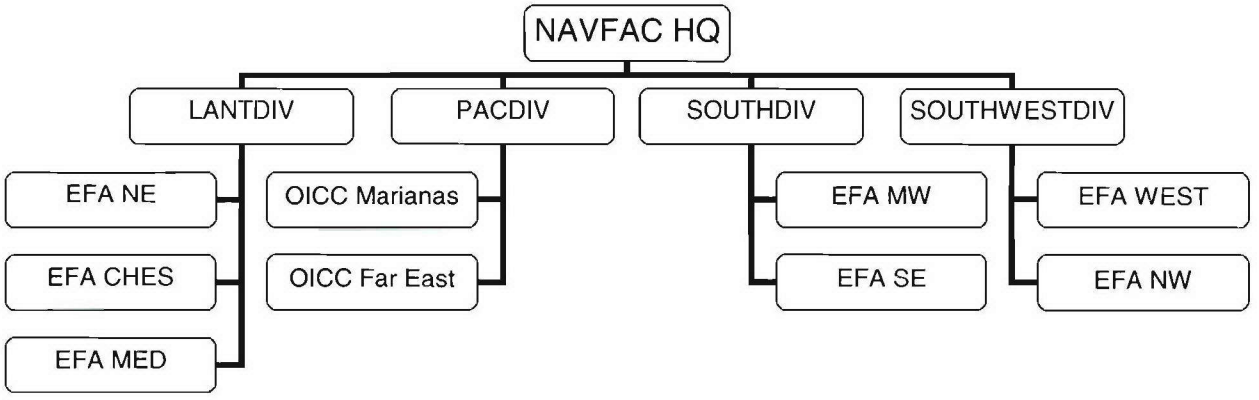


**Figure 4: NAVFAC Organization**

### 3.2.1 NAVFAC Headquarters

The main role of Headquarters with regard to facilities acquisition is to set policy and provide general guidance. There are six groups within the Headquarters, two of which have the primary influence on the operation of the construction administration field offices. Those two groups are the Engineer Operations Group and the Engineer Programs Group. The Engineer Operations Group has direct control over the Engineering Field Divisions (EFD) and the Engineering Field Activities (EFA) which execute the construction work. The Engineer Programs Group works to develop and fund construction work for execution by the Engineer Operations Group. The programs for which work is generated in this group are Military Construction (MILCON), Base Realignment and Closure (BRAC), Environmental Engineering, and Navy Housing. (NAVSCOLCECOFF, 2001)

### 3.2.2 Engineering Field Division

Subordinate to Headquarters in the organization of NAVFAC are the four Engineering Field Divisions. The area of responsibility for each division is based on geography. These geographical separations are shown in Figure 5. The EFD prepares and awards large contracts within its area of responsibility and upon award hands the contract to subordinates for execution. Another role of the EFD is to establish specific policy for its subordinate activities. Each Division is structured differently, but they all provide similar resources to their activities. These resources include but are not limited to the fields of safety, environmental, design, contracting, and legal.

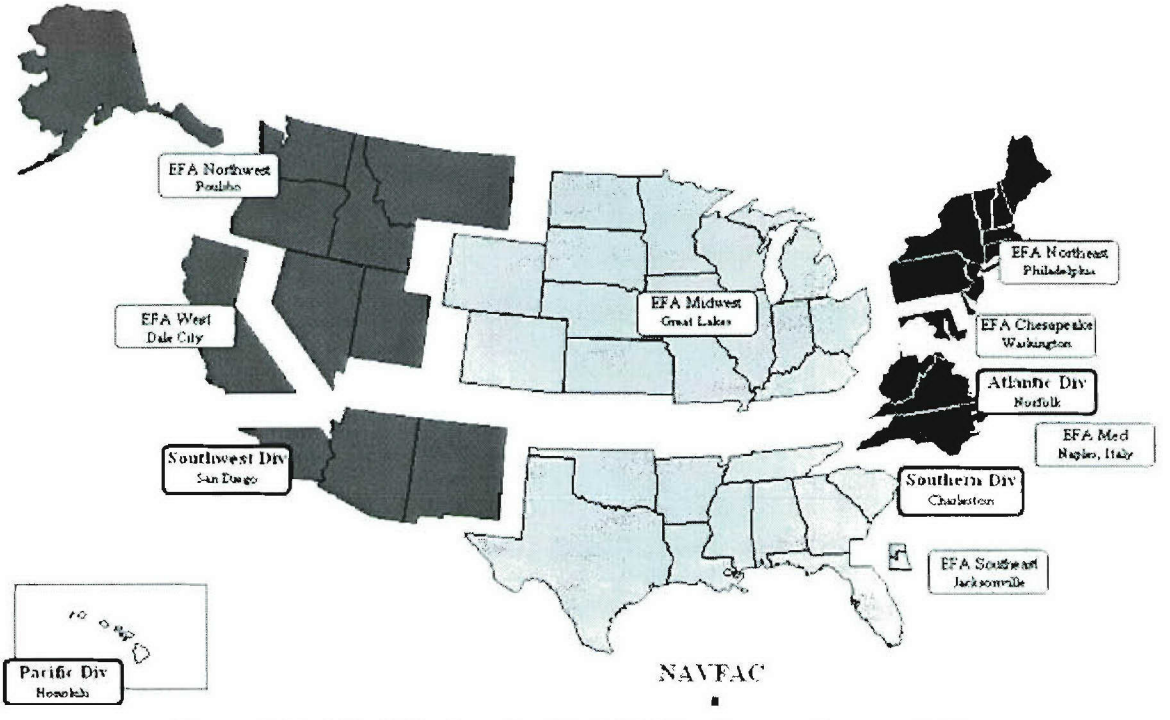


**Figure 5: NAVFAC Engineering Field Divisions' areas of responsibility**

### 3.2.3 Engineering Field Activity

It is evident in Figures 4 and 5 that the Divisions are further subdivided into units called Engineering Field Activities and Independent Officers in Charge of Contracting (OICC). EFA's control a more limited area and fill a similar role to that of the EFD to its subordinates in that area. An OICC is generally a smaller subordinate unit that is established in order to support a specific construction program in a location that is not easily supported by an EFD or EFA.

EFD's and EFA's are organized in a variety of configurations, but the components of the organization are similar. An example of this organization for EFA Northwest is given in Figure 6. The organization consists of a number of departments that develop and award contracts in their area of responsibility. When the projects have been developed and awarded they are given to the field office or Resident Officer in Charge of Construction (ROICC) in the geographical area of the project for execution. A project leader from the EFA remains on the project team for the execution phase of the project.

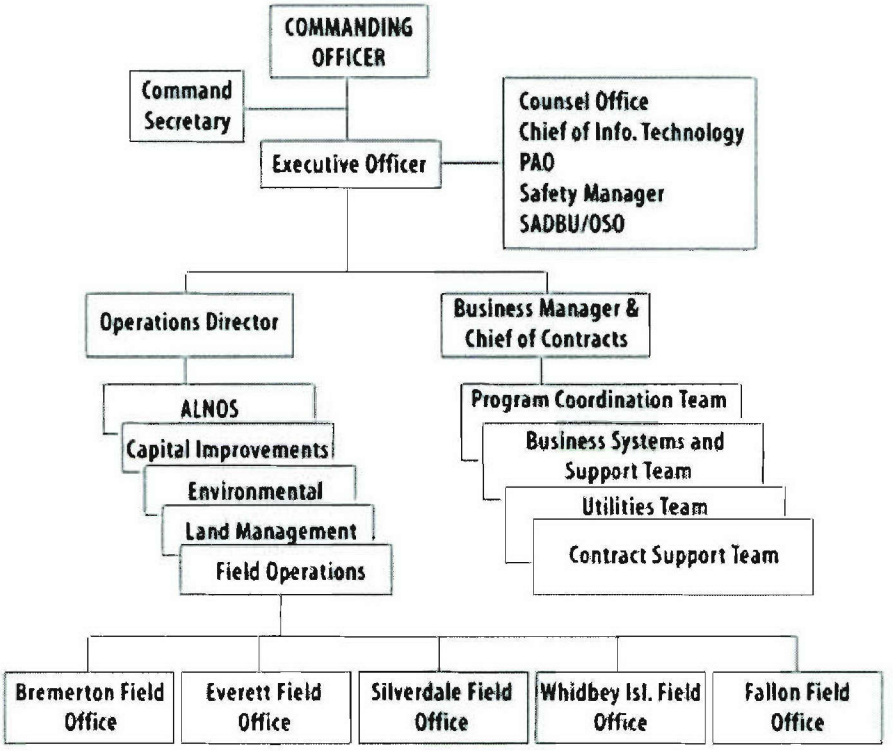


Figure 6: Engineering Field Activity Northwest organization

### 3.2.4 ROICC Office

The ROICC office, or Field Office as in Figure 6, is the final destination for construction projects as they flow through the organization of NAVFAC. The area of responsibility for a ROICC office is often one installation or a number of installations within close proximity to one another. The ROICC serves as the Government's first point of contact for the contractor and coordinates with the client and the base personnel which work for the installation on which the work is taking place. The ROICC office is responsible for the administration construction projects after it is awarded to a contractor. These responsibilities include ensuring quality, timeliness, safety, and environmental compliance. The ROICC also performs such administrative duties as processing progress payments,

negotiating contract changes, processing contract changes, and answering correspondence including Requests for Information (RFI's). (NAVSCOLCECOFF, 2000)

Along with administering construction contracts awarded by the EFD or EFA, the ROICC office also has limited contract award authority in its area of responsibility. The contracts awarded by the ROICC office are often task orders to existing contracts or small stand-alone contracts.

The ROICC office is where WebCM will be implemented in the facilities acquisition process of NAVFAC. For this reason it is most important to understand the organization of a typical ROICC office and the duties of the positions within the organization. A typical ROICC office organization is displayed in Figure 7. This is a simple representation of a ROICC office organization. The actual organization will vary based on the size of the office and the size of the area serviced by the office. The positions and duties will remain constant regardless of the organization and these are described below.

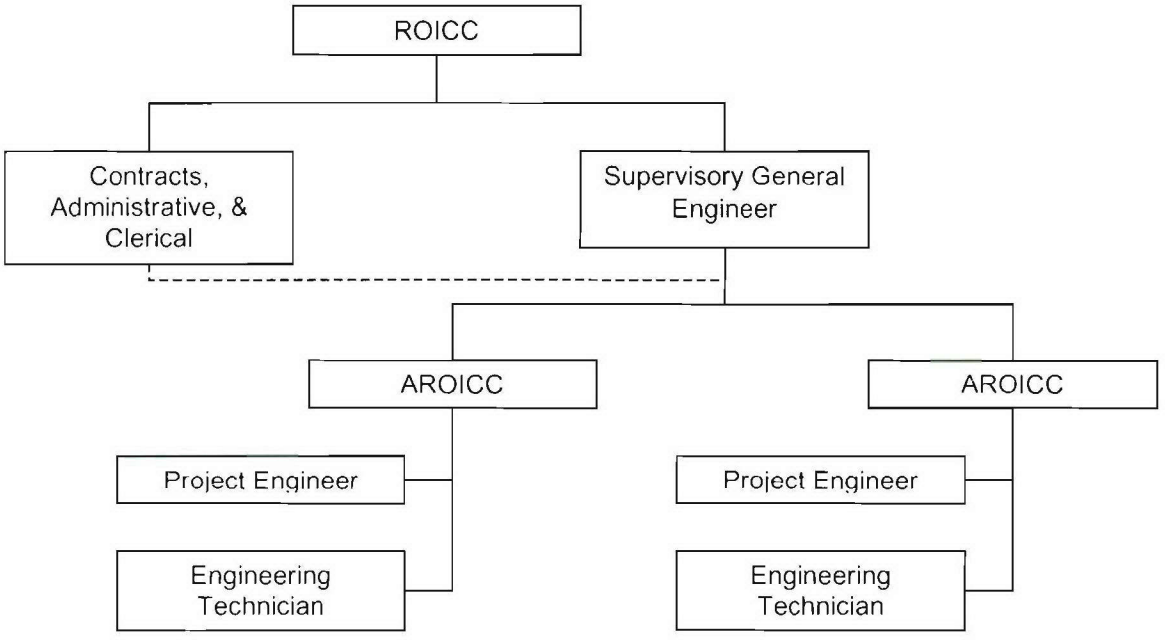


**Figure 7: Example of ROICC office organization**

### 3.2.4.1 Resident Officer in Charge of Construction

The ROICC is responsible for the post-award functions of all contracts that are administered by the office and the contracts awarded by the office. This includes staying in constant communication with the base customers within the area of responsibility and advising them on available contract types and contracting methods. The ROICC is the manager of the office, setting office specific policies and communicating activity or division-wide policies. The ROICC is also in charge of ensuring proper man-power for current and future workloads.

### 3.2.4.2 Supervisory General Engineer

The Supervisory General Engineer (SGE) is in charge of the execution of construction projects for the office. The SGE manages the personnel that

administer the contracts and acts as an advisor for technical matters concerning the projects. The SGE communicates the status of active and future projects to the ROICC and ensures any potential issues are properly communicated.

#### 3.2.4.3 Contracts, Administrative, and Clerical Personnel

Contracting personnel are responsible for awarding and modifying contracts within their warranted authority. They are also responsible for advising the other members of the organization on contractual issues. Federal contracts must comply with many regulations and these people are the experts in that field and ensure the office is complying with these regulations.

The administrative and clerical staff is concerned with the daily clerical requirements of the office. This includes the processing of progress payments, data entry, and coordination of base access to contractor personnel.

#### 3.2.4.4 Assistant Resident Officer in Charge of Construction

The AROICC is in charge of a specific project team that administers construction contracts. The number of AROICC's in an office is dependant on the workload. An AROICC ensures that the construction phase is operating smoothly and that communication between the contractor and the government is timely. Specific duties of the AROICC include constructability reviews, contract interpretation, preparation of contract change estimates, and contract change negotiation.

#### 3.2.4.5 Project Engineer

The Project Engineer is part of the team lead by the AROICC which administers construction projects. A Project Engineer is usually a technical expert in some field relating to the construction industry, often they are professional engineers or registered architects. The role of this position is to answer the technical questions that emerge during construction on the Government's behalf. Specifically this includes constructability reviews, answering RFI's, creating change order scopes of work, and reviewing project schedules.

#### 3.2.4.6 Engineering Technician

Engineering Technicians (ET) are the day-to-day eyes and ears for the Government. They also are a part of the team lead by the AROICC. ET's are generally individuals that have worked in some fashion in the construction industry. Many times they are former construction tradesman. ET's are tasked with the daily coordination between the Governments and the contractor. They work closely with the project superintendent and the client to ensure the construction operations don't interfere with base operations and vice versa. The specific duties of the ET include collection and review of daily reports, quality assurance, and routine visits to the construction site.

### *3.3 NAVFAC Summary*

The organizations that make up NAVFAC's acquisition machine have been identified and described in this section. It is important to understand this

organization, especially at the Division and ROICC levels, in order to understand the challenges and potential benefits of implementing WebCM.

# 4 CONTRACT PROCESS

Understanding the contract process for Naval Facilities is critical in developing an awareness of what steps in the process will be affected by WebCM. In this section the process will be briefly described from project inception to closeout. An important distinction will be made between the ideas of "project management" and "construction management." It is important to keep a macroscopic view of the entire process and how WebCM dovetails into this process while analyzing the effectiveness of the web-based management tool.

## *4.1 Project Life-cycle*

NAVFAC administers many types of contracts with varying customers, funding sources, and project scopes. No matter the combination of these three variables the general project life-cycle is unmistakably similar. This process is showed schematically in Figure 8.

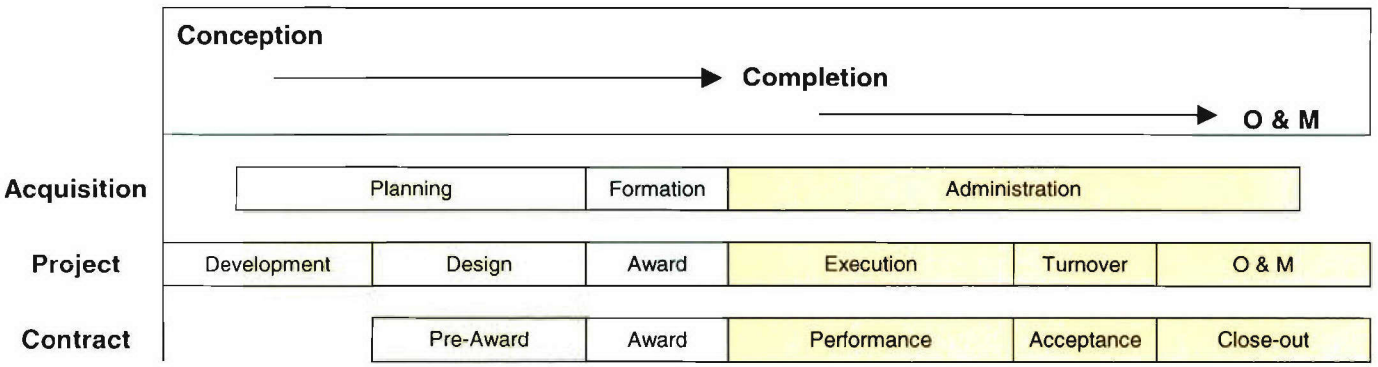


**Figure 8: Schematic of project life-cycle**

The process can be divided into three main phases or steps; planning, formation, and administration. These three phases are signified by the different colored bars in Figure (insert number). The process described and depicted here is the traditional design-bid-build process.

### 4.1.1 Acquisition Planning

The first step in any project is the determination of the need by the owner. The remainder of this phase involves development of the general requirements. The scope of the work to be performed is determined by the customer and contracting authority representative along with the source of the funds and the basic time requirements. In the case of a large or complex project, the design portion of the work will be contracted to an A/E firm. Based on these parameters the contracting authority chooses an appropriate contract type and contracting method for the construction contract.

Generally WebCM will not be a part of this phase of the project. The only exception will be in the case of design-build contracts. In this case the award of the contract occurs prior to design and the design activity would be subject to WebCM requirements.

### 4.1.2 Contract Formation

The formation phase consists of soliciting bids and awarding the contract. The major steps in this process are; preparation of the solicitation, publicizing the solicitation, submission of offers or bids, evaluation of offers, and award of the contract.

The current version of WebCM does not have the capability of including this phase of the project life-cycle.

### 4.1.3 Contract Administration

Contract administration is the phase in which the actual construction is performed and the completed work is turned over to the owner. The role of NAVFAC during this phase is to ensure the terms of the contract developed and awarded in the previous phases are met by the construction contractor. This includes assurance of quality, safety, environmental compliance, and timeliness.

The contract administration phase is the main focus of WebCM as it exists today. WebCM is intended to aid the construction administration phase by creating a web-enabled environment through which administrative and construction documents can be created, viewed, and shared by all authorized parties involved in the construction phase.

## *4.2 Construction Management versus Project Management*

It is important to create a distinction between the terms "construction management" and "project management" in order to establish the functional boundaries of WebCM. Project management can be thought of as one level higher than construction management in the overall management hierarchy. It involves general oversight of project scheduling and funding. Also considered is the overall base or area construction plan which includes other construction projects and their interrelation. Construction management on the other hand focuses on the post-award execution of one particular contract. Construction

management is a more detailed level of management that is a sub-part of project management.

## 4.3 NAVFAC Project Integration Vision – ieFACMAN

There are many different levels of management within the production chain of NAVFAC, construction management being one. The end goal for NAVFAC is to integrate all levels of management. The integration initiative is called ieFACMAN or **I**nteroperable, **E**nterprise **Fac**ility **Man**agement. A schematic of ieFACMAN is given in Figure 9.

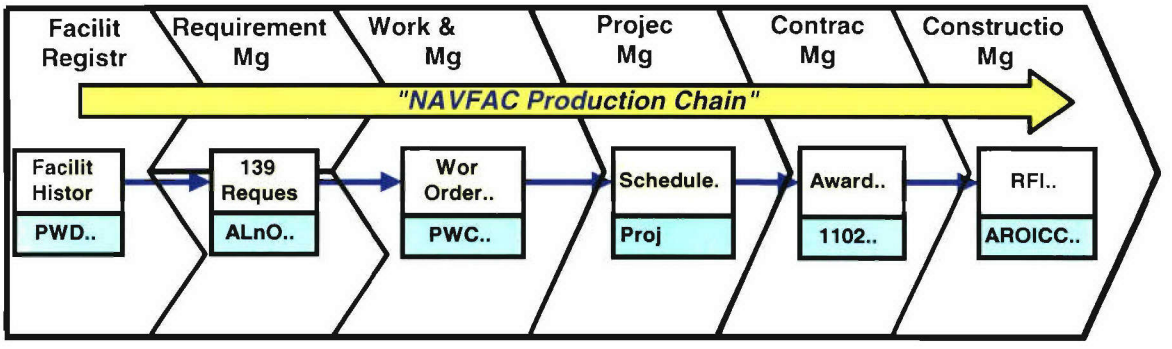


**Figure 9: Schematic of ieFACMAN initiative**

The goal of ieFACMAN is to create an automated production chain within NAVFAC. By integrating all the different levels of management the hope is that an integrated view of projects will be created which will aid in the decision making process. Another goal of ieFACMAN is to eliminate redundant transactions across the production chain therefore increasing productivity and reducing the chance of discrepancies.

The primary purpose of introducing ieFACMAN is to illustrate where in the process WebCM is located and its boundaries. WebCM is designed to be used solely for construction management but must also have the ability to integrate with the management systems of the other levels of management. In Figure 9 it is clear that construction management, and hence WebCM, is the final level in the production chain. The rest of the production chain and their management systems are not important to this discussion. What is important is the fact that construction management is at the tip of the management spear, where the work is actually put into place. This is arguably the most important part of the production chain. The management systems of all other functions may be perfect, but without commensurate management in the construction phase the project will likely not be a success.

# 5 CONSTRUCTION ADMINISTRATIVE REQUIREMENTS

Construction projects for any large owner require many administrative submittals before, during, and after the construction phase. NAVFAC contracts are no different and most likely contain more requirements than contracts let in the private sector. NAVFAC is a Federal entity and uses public funds and therefore must comply with many regulatory agencies.

The typical administrative requirements for NAVFAC can be divided into three distinct categories; pre-construction requirements, construction phase requirements, and contract close-out requirements. This section introduces the major administrative requirements for a typical NAVFAC contract with the purpose of attempting to understand what types of communications WebCM must handle. The administrative requirements listed here are not all encompassing, but represent the major requirements that are included in the majority of NAVFAC construction contracts.

## *5.1 Pre-Construction Phase*

The requirements presented here are required to be submitted by the Contractor and accepted by the Government prior to receiving a construction notice to proceed.

### 5.1.1 Certificate of Insurance

The contractor is required to carry insurance that covers any of the perils to which the contractor is exposed. The amount of the insurance policy varies from contract to contract. (FAR, 2004)

### 5.1.2 Surety Bonds

Payment and performance bonds are required for any contract exceeding $100,000. Both the payment and performance bonds must be in an amount equal to or greater than the contract amount. (FAR, 2004)

### 5.1.3 Environmental Protection Plan

An environmental protection plan is required which is a site specific plan for protecting the environment from any hazards that may be introduced by the construction project. The plan must be in accordance with Unified Federal Guide Specification (UFGS) 01575N. (UFGS 01575N, 2003)

### 5.1.4 Accident Prevention Plan

An accident prevention plan must be submitted in accordance with the Army Corps of Engineers EM 385-1-1 safety manual. The plan gives site specific guidance regarding the prevention of accidents which could cause harm to personnel or property. (USACE, 2003)

### 5.1.5 Quality Control Plan

The quality control plan documents the authority and responsibilities of the quality control organization. It also documents the procedures for ensuring quality during the construction of the project. It is to be completed in accordance with UFGS 01450N. (UFGS 01450N, 2004)

### 5.1.6 Baseline Schedule

A CPM network schedule must be submitted in accordance with UFGS 01321N. When accepted this schedule will provide the baseline for determining progress and settling disputes.

### 5.1.7 Schedule of Prices

The schedule of prices is a list of all activities and how much will be billed for completion of each activity. This is used to determine and verify the amounts of progress payment invoices.

### 5.1.8 Personnel List

The contractor must submit a list of all personnel that will work on the project. This list is used for badging purposes and as a contact list for the project.

### 5.1.9 Submittal Register

A submittal list is a document that contains all submittals that are required over the life of the project. The list includes spaces for submittal information such as approving authority, submittal date, and approval date.

### 5.1.10 Design Submittals

Design-build projects require submittal of design documents at various stages of completion. The design documents are reviewed for constructability and ultimately accepted for construction.

### 5.1.11 WebCM Personnel List

Contracts using WebCM require the contractor to submit a list of personnel that need access to WebCM capabilities. The level of access for each person must also be specified.

## *5.2 Construction Phase*

The construction phase contains many administrative requirements at differing intervals throughout the contract. The submission of many of these requirements is linked to the payment of progress invoices.

### 5.2.1 Daily Reports

The contractor is required to submit a daily report which summarizes the day's happenings. The report is completed on a standard form and lists happenings such as construction activities performed, hours worked, weather, and safety incidents.

### 5.2.2 Technical Submittals

Submittals are required for materials and equipment that are to be used in the construction. Different entities have approval authority for different submittals, but they must be approved prior to use or installation at the site.

### 5.2.3 Shop Drawings

Shop drawings are similar to technical submittals. They are required for items such as reinforcing steel fabrication and structural steel fabrication. They are reviewed by the design engineer to ensure they comply with the design.

### 5.2.4 Test Reports

Test reports are required for various materials and equipment that attest to their compliance with the specifications.

### 5.2.5 Requests for Information

The contractor submits an RFI whenever there is a question regarding the design documents. RFI's are normally answered by the design engineer but require review and acceptance by the Government. Often change orders are a result of an RFI if the design was incorrect or ambiguous.

### 5.2.6 Change Order Scope of Work

A change order scope of work is given to the Contractor when a change is proposed to the accepted design. The scope of work is generated by the design engineer and reviewed by the Government.

### 5.2.7 Change Order Proposals

The contractor must submit a change order proposal for each proposed change. The proposal must include a price for the change broken down by line item costs.

### 5.2.8 Invoices

The contractor submits invoices for progress payments throughout the execution of the work usually on a monthly basis. The invoice includes a list and amount of all activities that have been performed since the last invoice.

### 5.2.9 Schedule Updates

A schedule update is required with each invoice. The schedule is updated with all work performed in the period along with any change orders that were executed during the period.

### 5.2.10 Submittal Register Updates

A revised submittal register is required with each invoice. The register should contain the dates for all submittal submissions and approvals.

### 5.2.11 Employee Payrolls

Employee payrolls are required with each invoice. The payrolls are used to ensure the workers are being paid in accordance with the Davis Bacon Act. This act provides a minimum wage for each work classification for workers on Federal jobs.

### 5.2.12 Activity Hazard Analyses

An activity hazard analysis is required for each definable feature of work prior to initiation of that work. The activity hazard analysis defines all hazards that are present for the work and proposes actions to eliminate or mitigate the hazards. The analysis also lists the equipment to be used and any training that is required for the equipment.

### 5.2.13 Accident Reports

Accident reports must be submitted for any reportable accidents. The time for submission varies based on the severity of the accident.

## *5.3 Closeout Phase*

Upon completion of the construction there are still a number of administrative requirements that must be submitted by the contractor to the Government. These submittals focus on making sure the Government has all the necessary documentation and training required to run and maintain the facility properly. All of these requirements must be met prior to the contractor receiving final payment for the project.

### 5.3.1 Validation of Training

The contractor must submit a document that lists all of the training that has been performed for any of the building systems that require training. This ensures that the people that will maintain the facility are properly trained to do so.

### 5.3.2 Operations and Maintenance Manuals

The contractor must submit manuals detailing the procedures for maintaining the facility and all of its systems. The manuals must conform to UFGS 01781. (UFGS 01781, 2001)

### 5.3.3 Warranty List

The contractor must supply the warranty data for any products or systems used in the construction of the facility. This data is used as a reference in case of product or system failure.

### 5.3.4 As-built Drawings

The contractor must submit as-built drawings that incorporate all changes made to the original design. This set of drawings should be representative of exactly what was built in the construction phase.

### 5.3.5 Final Release

The contractor is required to sign and submit a formal document that officially turns the facility over to the customer. This is a standard document generated by the Government that must be stamped with the contractor's seal and signed by an employee of the company with adequate authority.

## *5.4 Administrative Requirements Summary*

The requirements described in this section provide an insight into the labyrinth of administrative documents that must be navigated by the contractor and the Government for NAVFAC contracts. Undoubtedly there are even more administrative submittals and correspondence on any given contract than listed here. The administrative requirements described here are summarized in Table 1.

**Table 1: Summary of NAVFAC contract administrative requirements**

| Pre-Construction | Construction Phase | Close-out |
|---|---|---|
| Certificate of Insurance | Daily Reports | Validation of Training |
| Surety Bonds | Technical Submittals | Operation/Maintenance Manual |
| Environmental Plan | Shop Drawings | Warranty Lists |
| Accident Prevention Plan | Test Reports | As-built Drawings |
| Quality Control Plan | Requests for Information | Final Release |
| Baseline Schedule | Change Order Scope of Work | |
| Schedule of Prices | Change Order Proposals | |
| Personnel List | Invoices | |
| Submittal Register | Updated Schedules | |
| Design Submittals | Submittal Register | |
| List of WebCM Personnel | Employee Payrolls | |
| | Activity Hazard Analyses | |
| | Accident Reports | |

Based on the large amount of data that must be exchanged before, during, and following a construction project it seems logical that a centralized data exchange platform would be advantageous. NAVFAC's solution is the use of WebCM.

# 6 NAVFAC WEBCM

NAVFAC is a large, geographically diverse organization that administers about 11,000 construction projects each year. In 2001 the leaders of NAVFAC recognized the need for a single system to manage all of the construction projects. As it was then, project information was being tracked and stored in countless different manners across the organization and making heads or tails of this information organization wide was next to impossible. WebCM is NAVFAC's proposed answer to consolidate their global construction information in order to facilitate efficient construction management, standardize business processes, and prevent information loss.

## *6.1 NAVFAC WebCM History*

The need for a web-based construction management tool within NAVFAC was recognized and acted upon in 2001. At this time the peak of inflated expectations for the technology had passed and the hype cycle was slowly creeping up the slope of enlightenment. A 500-page Request for Proposals (RFP) was assembled and provided to construction industry software providers in February 2002 (Becerik, 2004). NAVFAC based the award of the contract on "best value" rather than low bid. This was due in large part to the volume and sensitivity of the information that would be stored and tracked in the system. A best value award allows the Government to evaluate factors other than price in determining the firm that best satisfies the requirements of the Navy.

The contract for NAVFAC WebCM was awarded to Primavera Systems Inc. in May 2002. The value of the contract is $8.5 million for five years and is based on Primavera's product called PrimeContract (Primavera Systems Inc. 2004). NAVFAC worked with Primavera for a year and half to tailor the product to meet their business process needs and utilized the standard Government forms. The finalized product was first implemented in September 2003.

## 6.2 *Primavera Requirements*

The requirements for the performance contract of Primavera are obviously numerous being that the RFP contained 500 pages. Most of these requirements are typical of any contract for providing such services, but some are unique to the contract with the Navy. These are the requirements that will be presented.

NAVFAC included a requirement in the RFP pertaining to potential bankruptcy of the firm. This requires that Primavera place the source code and all project data in escrow for NAVFAC. This would allow NAVFAC to continue to use the product if Primavera should fall on hard times. Similarly the contract requires that all data belongs to NAVFAC. Primavera has responsibility to maintain and administer the database, but the data belongs to NAVFAC and will be handed over upon completion of the service contract.

The security of the data and access security were major issues while developing the contract. Primavera provides folder-by-folder and document-by document security to all of its clients, but the sensitivity of some of the information for NAVFAC required additional provisions in the RFP. Primavera is liable by Federal Law for both the security of the documents and access security

causing them to take extra caution in protecting the data on NAVFAC projects (Becerik, 2004).

## 6.3 Construction Contractor Requirements

The WebCM requirements placed on the construction contractor can be divided into upfront requirements for computer hardware and software and utilization requirements. All of these requirements are included in Unified Facilities Guide Specification (UFGS) 01322N which will be included in Division 1 of all contracts that shall use WebCM. This specification section is included in Appendix A.

The contractor is required to use computer hardware and software that meets the minimum recommendations issued by Primavera. This includes the use of programs that are compatible with the forms and documents that are inherent to the WebCM interface. The hardware requirements include adequate access to the internet for all designated WebCM users. The Government does not allow delays associated with internet connectivity problems or loss of information. The contractor is also responsible for ensuring the project personnel with access to WebCM are properly trained to use the hardware and software. Any costs that are associated with obtaining the hardware, software, or training must be included in the project overhead; a separate line item cost will not be accepted.

Along with the upfront requirements, the contractor must meet the utilization requirements delineated in the specification. Simply put, the contractor is required to submit anything that can be created and transmitted digitally

through WebCM. This includes design documents for design-build contracts. There are only a few exceptions to this rule including contract modifications, contract claims, and any other documents with legal consequences requiring an original document with signatures or seals. The only other exceptions are submittals such as product samples or color boards. These must be submitted physically, but a submittal cover page must still be submitted using WebCM.

## *6.4 User Interface*

The user interface for any technology is one of the critical aspects that can lead to its success or failure. This is especially the case in the construction industry which is largely skeptical of major changes. A basic understanding of the user interface in this case is important in order to understand some of the benefits and suggestions proposed in the next chapter. This section offers a brief description of the WebCM interface and navigation tools.

### 6.4.1 Permissions and Roles

In order to understand the user interface and capabilities fully it is important to understand the ideas of roles and permissions within WebCM. Each member of a project team is entered into the WebCM system and must be given both a role and a permission status.

The role (i.e. AROICC, QA Rep, Contractor (KTR) Superintendent, KTR QC, etc.) indicates which persons are responsible for specific steps in the workflow processes. For example, the workflow process for a daily production report is initiated by the KTR Superintendent and is automatically sent to the QA

Rep upon submittal. The QA Rep then reviews and either accepts or sends the report back to the Superintendent for re-submittal. This is an example of a simple workflow process with only two roles, but some processes involve many roles and many steps. All the defined roles must be filled by a project member in order for all work processes to flow properly.

Permissions in WebCM set limitations for what operations can be performed within the system. There are eight permission sets within WebCM. Each member is assigned a permission set upon entry into the system. These sets control the abilities of members to perform tasks such as viewing, saving, and altering documents.

### 6.4.2 Project View

The Project View within WebCM is essentially the project homepage. It is the interface for all of the project functions performed by WebCM. There are other views such as Enterprise View and Personal View. The Enterprise View uses a folder structure which allows users to select projects administered by specific divisions and ROICC offices throughout NAVFAC. Personal View allows users to customize the information that is displayed pertaining to their specific projects. Project View is the only view that is available to contractors and is where the project administrative functions are located. For these reasons this will be the focus of this discussion.

A screen capture of the Project View is shown in Figure 10. The page is setup similar to the folder structure used in most contemporary computer operating systems. A user navigates to the desired administrative function be

selecting the corresponding folder. The structure and operation of the Project View is simple and intuitive with basic computer knowledge and experience.

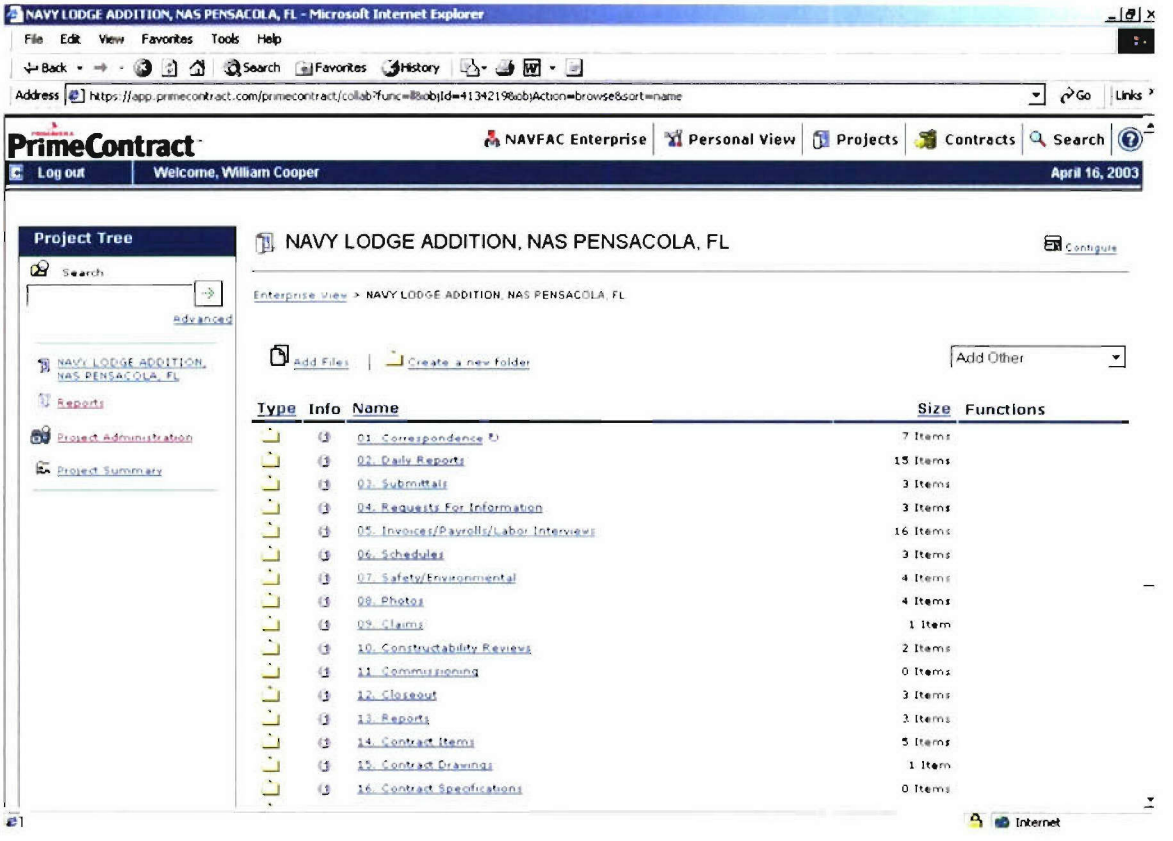


**Figure 10: Project View homepage**

The simplest way to show the operation of the system is to walk through a simple example of the workflow of a daily production report. The initiator of the workflow (KTR Superintendent in this case) navigates to the Project View and selects folder "02 Daily Reports". With this selection the screen in Figure 11 is shown. The superintendent would then select "2.1 Production Report" from the list of functions at the top of the screen. It should be noted that only the functions available to the role of the particular user would be shown on this screen. The

system would then lead the superintendent through a series of pages that prompt the user to insert the pertinent information for the report. Upon completion of each section the user would save the entered information and initiate the workflow for a daily production report.

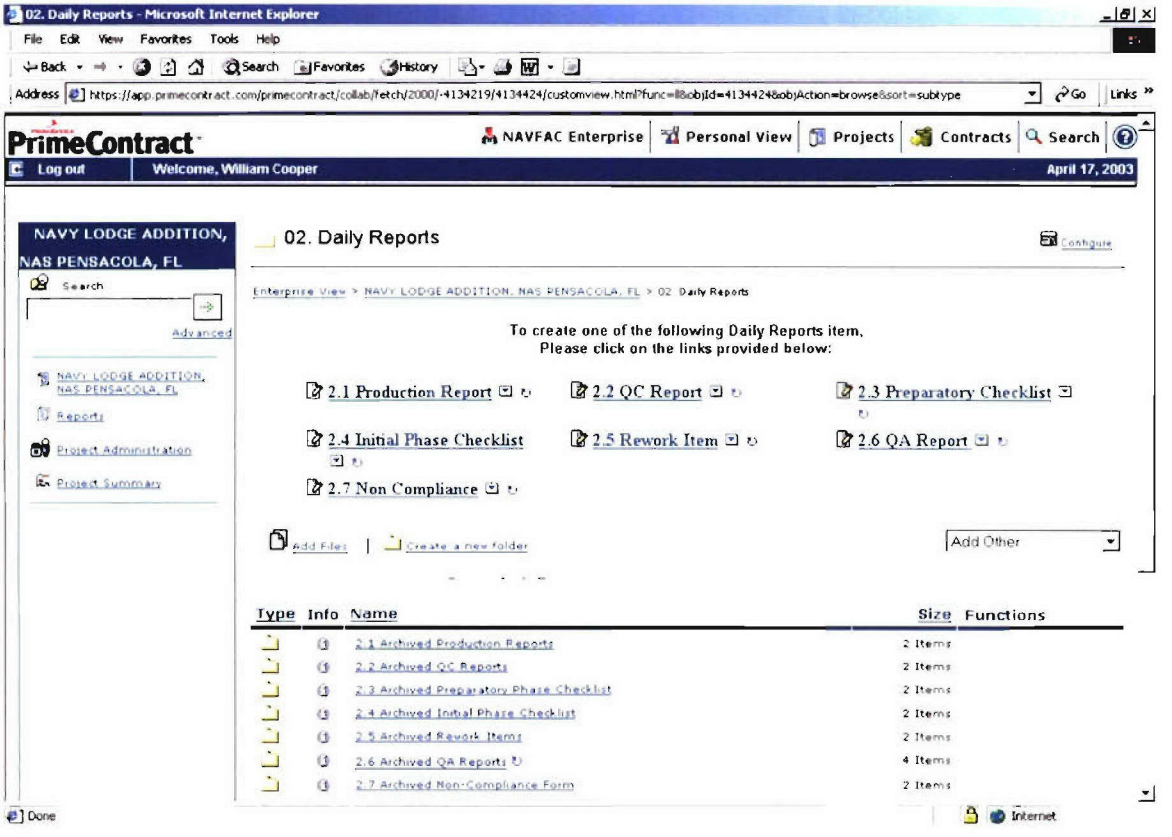


**Figure 11: Daily Reports function view**

The workflow for a daily production report is relatively simple. Once initiated by the superintendent the task flows to the QA Rep for review. Here the report can either be accepted or returned for revising. The tasks are accessed through the individual users' task lists. The QA Rep would simply click on the task in his/her task list, review the read-only report, and choose the appropriate

action button. Screen captures for the task list and selection of the appropriate action are shown in Figures 12 and 13 respectively.

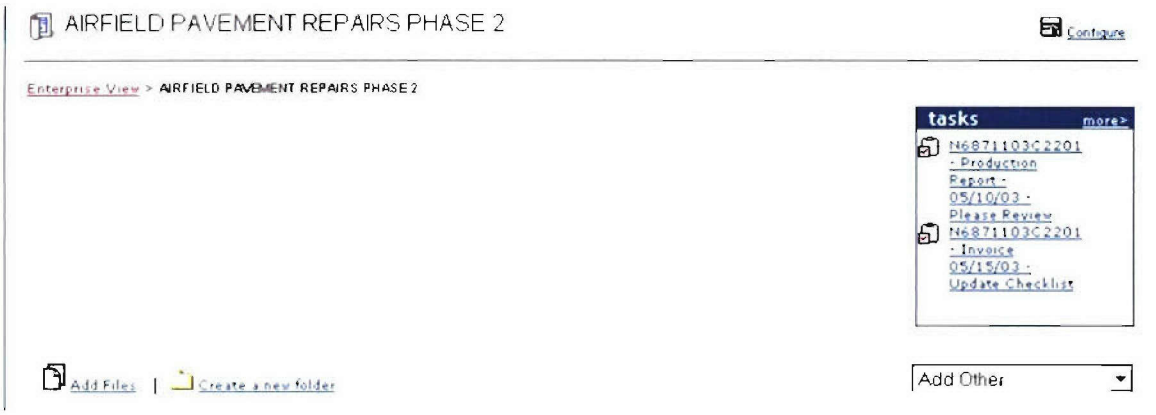


**Figure 12: Individual user task list view**

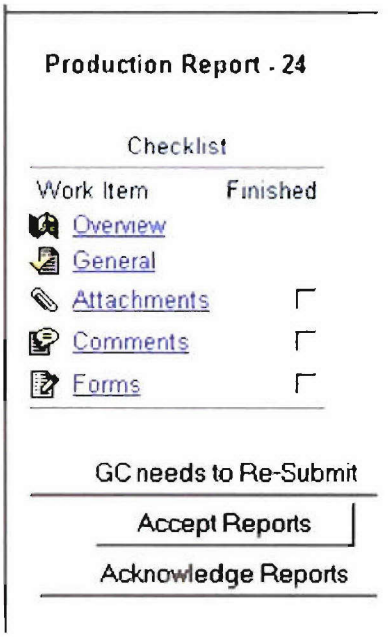


**Figure 13: Production report review action list**

An important concept when interfacing with the system is that of the work task and the process map. Each administrative requirement process has a

process map that is comprised of a number of work tasks. These work tasks are assigned to specific project personnel for completion. The process map directs the flow of work from task to task and from user to user. The first task in a workflow is an initiator and is followed by other tasks until the process is complete. In the example given above, the superintendent initiates the process. The process map indicates that the next task must be performed by the QA Rep so a work task is created for that user. If the QA Rep rejects the daily report, the logic in the process map would lead to a work task for the superintendent to revise and resubmit the report. This basic logic structure is used to form the work flow for each process.

## *6.5 WebCM Capabilities*

The capabilities presented by WebCM are vast, extending far beyond the ability to handle the administrative requirements of a NAVFAC construction project. It would be impossible to fully describe all of these capabilities so this discussion will focus on the basic abilities of managing administrative requirements and a few other specialized abilities that display possible immediate benefits.

The capabilities of WebCM to assist in the management of administrative requirements can best be shown as in Table 2 which lists all folders from the Project View (Figure 10) and the functions that can be performed in each folder. The functions for administrative requirements that use standard forms available in WebCM work on the principles of work process maps and work tasks as discussed earlier. Many of the functions are simply to store project data on the

database server for access by all personnel that have permission to view the folder.

**Table 2: Summary of folders and functions from the Project View**

| Folder | Functions |
|---|---|
| Correspondence | Speed Memo<br>Send Correspondence<br>Store Correspondence |
| Daily Reports | Production Report<br>QC Reports<br>QA Report<br>Rework Items<br>Non-compliance Notice |
| Submittals | Store Submittal Register<br>Manage Submittals |
| Requests for Information | RFI Submittal |
| Invoices/Payrolls/Labor Interviews | Process Invoices<br>Store Payrolls<br>Store Labor Interviews |
| Schedules | Viewable Schedules<br>Native File Schedules |
| Safety/Environmental | Store Safety Audits<br>Store Environmental Documents |
| Photos | Store Project Photos |
| Claims | Store Claim Information |
| Constructability Reviews | Link to DrChecks |
| Commissioning | Store Commissioning Documents |
| Closeout | Store Warranty Documents<br>Store Evaluations<br>Provide Closeout Checklists |
| Reports | Store Reports |
| Contract Items | Store Misc. Contract Items |
| Contract Drawings | Store Contract Drawings<br>Store As-built Drawings |
| Contract Specifications | Store Contract Specifications |
| Modifications | Create Proposed Changes<br>Create Modifications<br>Store Proposed Change Data<br>Store REA Data |
| Miscellaneous | Store Miscellaneous Data |
| Contract/Contact Information | Store Contract and Contact Data |
| Pre-Award | Store Pre-award Documents |
| Meeting Minutes | Store Meeting Minutes |

Other than these basic capabilities WebCM enables the users to perform many other specialized tasks. Many of these tasks are made available due to the structured nature of the data storage and the web environment which facilitates sharing and collaboration. The other capabilities include:

- Alerts – Alerts allow users to set automated notifications for events such as addition, deletion, or alteration of files. Other alerts can notify users when a workflow is overdue.
- Support Knowledge – This is an online forum that allows users to share knowledge and experience in troubleshooting problems and proper utilization. This is one of the keys to success of an internet based information system (Mak, 2001).
- Workflow Status – This feature allows users to view the status of all workflows that they are involved with. The status can be viewed as a logic map of the entire process with the current step highlighted for easy process visualization.
- Discussion Item – This feature allows users to add discussion items to the Project View. A discussion item is similar to a chat room and allows project personnel to collaborate real time.
- Add URL – The URL for any website can be added to the Project View to grant easy access to important information such as codes or standards.
- Reports – This feature allows users to run reports based on preset queries or queries they develop themselves. Reports can be run at the project level or the enterprise level.

The basic and specialized capabilities of WebCM are numerous and far-reaching. WebCM is able to manage and facilitate all administrative requirements associated with a NAVFAC construction project with only a few exceptions. The specialized capabilities allow WebCM to become sort of a one-stop shop for all project information. The web-enable environment puts all of these capabilities at the tips of all users' fingers from nearly anywhere.

# 7 WEBCM ANALYSIS

With the background provided regarding NAVFAC and WebCM, the potential benefits of this technology can be more clearly understood. These benefits are termed potential for the very reason this report was undertaken; in order for the benefits to be realized the technology must be fully adopted and utilized by the construction management team.

The benefits will be presented in two main groups, those that are systematic in nature and those that satisfy specific needs of NAVFAC. The discussion of the benefits is qualitative for two reasons. First, it is difficult to quantify the benefits of project management improvements regardless of the application. Second, WebCM was only introduced a short time ago on a few projects which have not produced sufficient data to conduct a quantitative analysis.

## *7.1 Systematic Benefits*

The systematic benefits made possible by WebCM are those that are inherent to such a system. They don't satisfy any particular requirements but they do improve overall communication and process efficiency.

### 7.1.1 Information Pull versus Push

Traditional project management infrastructure tends to favor linear information flow. The subcontractor communicates with the general contractor, the general relays this information to the Government, the Government

collaborates with the designer and so on until the information reaches its final destination. In most cases the information must flow through the same pattern again in reverse to finally arrive where an answer is needed. This linear flow of information takes time and also may be a contributor to information distortion.

The idea of pull versus push was first put to use in Toyota manufacturing plants and was called the kanban system. Kanban is a Japanese term for "signal" and the system was developed by Taiichi Ohno. They used the concept to control the flow of manufacturing work in progress rather than information. The idea was to pull orders from the end of the manufacturing process rather than pushing the orders from the beginning of the process thereby reducing the amount of work in progress and decreasing the chance of losing or mixing orders. The flow of information is slightly different from manufacturing flow but provides similar benefits.

The linear information flow example displays the idea of information "push" through a project management team. In a web-based management environment, all members of the project team can "pull" information from the central information server at any time. The only "push" is from the originator of the information who would post the information and make it instantly available to any of the team members who have action regarding this information. This one-time push reduces the time for issue resolution and ensures that the information is not distorted from its original form. Figure 14 displays a schematic of information push versus pull.

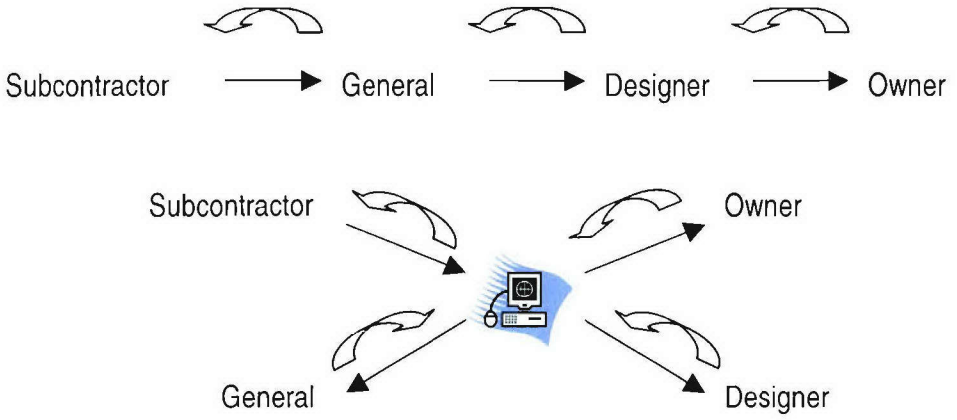


**Figure 14: Information push (top) versus pull (bottom)**

Another advantage based on the push versus pull concept is the reduction of information overload, similar to reduction of work in progress with the kanban system in manufacturing. Originally it was thought that use of email as a communication tool would benefit the project in much the same way as described in the previous paragraph. In reality, the use of email may actually hinder productivity. Members of the project team can copy every person involved with a project on a "just in case they need it" basis (Thorpe and Mead 2001). This forces members of the project team to evaluate each piece of information to determine whether it is pertinent to their specific duty. The sheer volume of information passed on a construction project overloads designers and project managers (Thorpe and Murray 1996). This also causes a problem when a specific piece of information is needed. The person seeking this information must wade through countless pieces of correspondence in order to find the specific piece of information they desire. WebCM would eliminate the need to overload all team members with information. The information would be stored in

a central location available to be viewed on a "just in time" basis as opposed to "just in case" (Thorpe and Mead 2001).

### 7.1.2 Team Geographic Diversity

WebCM provides the connectivity to increase efficiency of project teams made up of individuals spread throughout wide geographic areas. NAVFAC has field offices throughout the world and many times it is not possible to have all project team members in the same area. There are three main project benefits that arise from this fact; enhanced information availability, ability to involve specialists not available locally, and travel costs of team members can be dramatically reduced.

Many times it is beneficial to employ team members from all over the world for construction projects, especially in specialized applications. This was made much more plausible with the advent of electronic communication and is even further enhanced with WebCM. Time zone differentials can pose a problem when it comes to geographically diverse project teams and information availability. Even the three hour difference from the east coast to the west coast could be a problem if information is needed by an individual at a time outside the normal working hours of the opposite coast. This problem is compounded when projects with international project teams are considered. WebCM allows for immediate access to up-to-date project documents regardless of the time of day or geographical location.

The trend towards geographically diverse project teams causes increased travel and shipping costs. Shipping and mailing costs are avoided by making all

project documents available electronically. Using traditional project management, it is customary to have a number of physical meetings with the project team. The project must absorb the travel cost which leads to an increase in the total cost to the owner. WebCM can reduce these extraneous travel costs. A team which actively uses this management tool can decrease the frequency of physical meetings. The constant flow of accurate, up-to-date information takes the place of some these costly physical meetings. Also, these meetings could be replaced with the discussion item live chat function of WebCM.

## *7.2 NAVFAC Specific Benefits*

This section will focus on the immediate benefits to the construction administration and management within NAVFAC. These are the benefits that can be easily perceived by the employees of NAVFAC if the time is taken to learn the basics of WebCM use.

### 7.2.1 Paperless Office

The paperless office is an idea that has been around for over a decade. While a true paperless office is not likely to exist for many years, a less paper office is possible with current technology. The Department of Defense issued a policy for transition to a digital environment for acquisition programs in 1997. This policy states that an "overwhelming majority" of acquisition operations should be based on digital methodologies by 2002 (Deputy Secretary of Defense, 1997). WebCM is one technology that moves NAVFAC closer to the elusive paperless office and aids in compliance with the DOD policy.

Aside from complying with DOD policy and the obvious reduction in natural resource usage, storing contract documents digitally shows distinct advantages for NAVFAC. The administration of construction contracts is a document intensive operation. Even with the finest filing and organization system, large volumes of paper documents can lead to difficulties in both location and storage. Digital documents on the other hand allow users to search for specific items expeditiously and can be stored in large numbers on a single server or hard drive.

### 7.2.2 Process Standardization

Business process and form standardization provides a major benefit to NAVFAC. Prior to WebCM, NAVFAC used many different systems for contract administration. The systems varied from location to location and from business process to business process. This made it difficult or impossible to compile data for organization wide metrics and confused employees and contractors when shifting between different areas of the organization. WebCM provides solutions to both of these shortcomings.

Metrics and reports are widely used in throughout NAVFAC to measure the effectiveness of the business processes and the project teams. Prior to WebCM many of the metrics had to be manually constructed by managers with input from the project teams which was a time consuming process for the field personnel and the managers. This method of data gathering can also easily lead to misrepresentation of data due to multiple iterations of data entry and compilation. WebCM provides NAVFAC wide standards for business processes

and administrative forms. It also allows the data from these forms to be stored electronically in a database. These attributes make it possible for managers at any level in the organization to compile accurate performance metrics and reports in far less time and without removing field personnel from their primary duties. They also provide signals to areas where improvements are needed.

Standardization also allows for easy transition of employees and contractors to different organizations within NAVFAC. When different processes and forms are used in different areas both employees and contractors can be confused. This confusion can lead to delays in all phases of contract administration because of the learning curve. With WebCM, once an employee or contractor has learned the standard processes the knowledge can be applied to all future positions and contracts thus avoiding any delays due to the learning curve.

### 7.2.3 Reports

Report creation time is greatly reduced by WebCM. This is another result of standardization, but deserves its own subpart because of the magnitude of the potential benefit. From experience, the author knows the frequency and time involved with creating status reports regarding the progress of active projects. An AROICC may spend as much as one day per week creating and editing reports and more than that during certain parts of the year. Undoubtedly similar reports are required at all levels of the NAVFAC organization and just as much time is spent on them at each level. WebCM has the potential to significantly reduce the amount of time spent on recurring reports.

WebCM allows users to run preset common reports and also create custom reports that can display any information desired by the user. These reports can be run at any level of the organization. This ability liberates all members of the NAVFAC organization from spending many hours or days per week creating reports and allows them to focus on their primary duties.

### 7.2.4 Prioritization of Work Tasks

Proper time management and prioritization of duties for individuals is one critical aspect of the efficiency and success of any organization. Time management is already made possible by the use of date books or software such as Microsoft Outlook. In Personal View WebCM allows individuals to visualize a list of all of the project specific tasks they are charged with completing. With all of the work tasks visible it is much easier to prioritize and organize the use of time. The combination of date books or calendars with WebCM eases the process of fitting in the execution of the work tasks with scheduled meetings and other duties in order to most effectively use time.

### 7.2.5 Audit Trails

WebCM creates audit trails for both revisions to documents and execution of work processes. This will prove most beneficial for the resolution of claims and the settlement of time disputes. WebCM will maintain a record of the exact dates of task execution and the different versions of contract documents. This will give both the contractor and the Government a more complete understanding of the facts in the case of disputes. Complete knowledge of the facts should

decrease the frequency of contract claims and ensure a fair and reasonable settlement.

### 7.2.6 Client Service

The ultimate goal of construction projects administered by NAVFAC is customer satisfaction. All of the benefits provided to NAVFAC are ultimately passed on to the client in the form of quality construction performed on schedule and within budget. WebCM also provides accessibility benefits to the client during the construction phase. NAVFAC clients are given specific permissions and roles in WebCM which gives them access to many of the capabilities. The project schedule is usually one of the most important documents to the client. They need to know when phases of construction will be complete and when the construction operations will affect other tenants on the base. WebCM allows the client to view the most updated schedule at any time and view other documents such as meeting minutes which will indicate upcoming construction operations. Providing clients with access to this up-to-date information ensures that stay informed even when ROICC personnel are not available.

## *7.3 Suggestions for Implementation*

The implementation phase of WebCM is probably the most critical in terms of deciding success or failure. The suggestions described here are based both on the analysis of the author and data gathered from case studies of similar construction management endeavors in the private sector. The lessons learned can be applied to NAVFAC WebCM to increase the likelihood of success.

### 7.3.1 Develop Cost Savings Measurement Tool

The benefits of WebCM come in the form of tangible monetary benefits (i.e. time and cost savings) and intangible benefits (i.e. fewer errors, client satisfaction). The intangible benefits are difficult to quantify and measure, but a system for measuring the tangible benefits can be useful in influencing the acceptance of WebCM by managers, employees, contractors, and clients. Showing people that WebCM is financially beneficial to all parties with real project data will go a long way in ensuring the technology's success. It is beyond the scope of this report to propose a method for time and cost savings measurement, but when more WebCM project data become available this would be useful to investigate.

### 7.3.2 Project WebCM Champions

A case study performed by Thorpe and Mead (Thorpe and Mead, 2001) shows that the success of a technology like WebCM is dependent upon the participation of a few key project team members. These key members most often are the middle manager levels in the participating organizations. In a NAVFAC project this would include the AROICC, contractor superintendent, and lead designer. If these key individuals can be influenced to utilize WebCM the other team members will be more likely to adopt it as well. Participation of these members can be enhanced by thorough training and understanding of the benefits. The case study also suggests that the organizations could designate these individuals as project technology champions and give them the responsibility of ensuring WebCM participation of the entire team.

### 7.3.3 Training and Re-training

Nearly all of the case studies from the private sector indicate that user training is a primary key to success. It is quite obvious that failure will be the result of untrained users. The project personnel will revert back to the old way of doing business because the WebCM processes will be perceived to be more difficult and time consuming. A PowerPoint presentation with more than 700 slides of screen captures and instructions is evidence that NAVFAC is serious about training all of the eventual users. The training program should also include hands on training seminars in which the users are able to navigate the system through examples. One case study suggests retraining may also be useful after the users have worked on a WebCM project. This training session could focus on the problems and questions encountered by the users during use. This amount of training may seem costly and time consuming, but will pay dividends with the future success of WebCM technology.

## *7.4 Suggestions for Technical Improvement*

### 7.4.1 Collaboration Software

WebCM presents the ability to collaborate with the project team real time with the discussion item feature. This feature is run similar to a chat room in which team members can interact real time with written messages. Collaboration software similar to Microsoft Live Meeting™ enhances the collaboration abilities and further reduces travel costs associated with physical meetings. This type of software allows those with access to share voice, applications, and files in real

time through the use of phones and the internet. Through this tool it is possible to give presentations to large groups of people or hold meetings with groups of up to 20 people all without anybody leaving the office. Microsoft itself was able to reduce travel costs by 30% in the first six months of internal use ("Live Meeting," 2004). Beyond the money saved on direct costs of travel and lodging, reduction in travel saves time by removing travel days associated with physical meetings. A one-day meeting often means three days out of the office for those that have to travel, but with collaboration software a one-day meeting is truly that for all participants.

### 7.4.2 Notebook or Tablet Personal Computers

One possible complaint from field personnel regarding WebCM could be the duplication of effort when creating documents in the field. These documents will have to be generated again in the WebCM forms provided or otherwise in a digital format. This situation could be circumvented by the issuance and use of notebook or tablet personal computers. With these computers the field personnel could initially create the documents in a digital format that could be easily uploaded to WebCM upon returning to the office or any location with a connection to the internet.

Another possible advantage of using tablet PC's in particular is their ability to display and allow the alteration of documents in a manner that is similar to hard copy documents. Many people are used to and comfortable with reading documents in hard copy and manually making notes on the original document. Tablet PC's are configured in such a way and contain software that allows users

to view and annotate documents similar to hardcopies. The annotated documents can be saved digitally and the notes can be viewed and further altered by anybody with the proper software. Using these computers could increase the chances of acceptance by field personnel and thus increase the chances of success for WebCM.

### 7.4.3 Field Connectivity

The ability of field personnel to connect to the internet and WebCM in the field will further enhance the speed at which information is made available to the project team. This could be particularly helpful for high profile, fast-moving projects. Besides allowing field personnel to instantly upload documents to WebCM, field connectivity would also make possible instant access to all WebCM's capabilities while in the field. Field connectivity can be made possible by the use of Personal Digital Assistants (PDA's) with a cellular internet connection or portable computers with wireless internet connections. The latter would require wireless routers at project locations which probably are not currently available, but wireless internet connections are becoming more commonplace as the technology evolves. Some universities, businesses, and other institutions currently provide wireless internet connections in their buildings and on their grounds and it would be possible to provide the same service to military installations.

### 7.4.4 Web-cams

The use of web-cams in conjunction with WebCM could improve the documentation of project progress and ease the gathering of pictures for reports. The web-cams would not replace the need to take photos of specific events and operations, but could be useful for certain function provided by WebCM. Web-cams at the project site could be set to automatically take and save progress photos at certain times everyday. These photos could be attached to the daily reports in order to more clearly identify project progress and inclement weather. The web-cam photos could also be automatically set to appear in reports that require a photo. The photos would be taken from a constant perspective and would always show the most recent condition of the project site.

# 8 CONCLUSION

Web-based construction management can be a successful tool in an organization as large, dispersed, and regulated as the Naval Facilities Engineering Command. WebCM based on Primavera's PrimeContract is the construction management tool NAVFAC has chosen for implementation.

Currently NAVFAC is at the critical stage of implementation of this new technology. The criticality of the situation is magnified by the history of reluctance in the construction industry to embrace business technologies. In order for WebCM to be a successful tool in the administration of construction contracts the users (NAVFAC employees, contractors, and clients) must have the necessary knowledge to effectively utilize the system and the willingness to accept this new way of doing business. Successful implementation of WebCM may have implications greater than just its own success. Acceptance of WebCM may be a stepping stone for future project management and information technology improvements within NAVFAC.

One way to positively influence the acceptance of this new technology is to ensure the users understand its capabilities and the associated potential benefits. Over time some of these benefits will be able to be expressed quantitatively in the form of time and cost savings, but at this early stage of implementation they can only be expressed qualitatively. The promoters and users of WebCM must understand that these benefits will only be realized if the tool is effectively utilized.

This report has broached a number of topics that require further investigation in order to fully understand. The investigation of these topics is beyond the scope of this report, but could be the subject of further research. One of these topics is the idea of generating documents in the field and digitally sending them to the office or a web server. PDA's and notebook PC's with wireless capabilities were suggested in this report and another possibility is the digital hardhat (Stumpf, et al, 1999). Further research could be undertaken to determine the most effective method for the construction industry and possibly quantify the benefits of any of these technologies.

Another area for possible further research is the development of a cost and time saving measurement tool. This report suggests developing one specifically for NAVFAC's WebCM, but such a tool would be useful that could quantify these benefits for any information technology applied in construction management. A robust tool that can accurately show quantifiable benefits of a technology will influence the acceptance from the perspective of both management and field personnel and may be a step forward in removing the reluctance of accepting technological advancements throughout the construction industry.

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# APPENDIX B: WEBCM SPECIFICATION

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**USACE / NAVFAC / AFCESA UFGS-01322N (April 2004)**

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**Preparing Activity: NAVFAC Superseding**
**UFGS-01322N (February 2004)**
**UNIFIED FACILITIES GUIDE SPECIFICATIONS**
**Latest change indicated by CHG tags**

**********

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01322N

WEB BASED CONSTRUCTION MANAGEMENT (WEBCM)

**04/04**


-- End of Section Table of Contents --

UNIFIED FACILITIES GUIDE SPECIFICATIONS

Latest change indicated by CHG tags

**********

SECTION 01322N

WEB BASED CONSTRUCTION MANAGEMENT (WEBCM)
04/04

**********
NOTE: This guide specification covers the requirements for the use of NAVFAC's WebCM web-based construction management program.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
**********

**********
NOTE: WebCM may be used on any sized project, at the discretion of the administering ROICC Office.
**********

PART 1 GENERAL

1.1 DESCRIPTION

**********
NOTE: Include the bracketed phrase if the project will be Design Build.
**********

The Government and Contractor shall utilize the Naval Facilities Engineering Command's (NAVFAC) WebCM system for electronic submittal of all data and documents (unless specified otherwise by the Contracting Officer) throughout the duration of the Contract. WebCM is a web-based electronic media site that is hosted by Primavera Systems, Inc. utilizing their

PrimeContract (hereinafter referred to as WebCM) web solution and will be made available only to key Prime Contractor personnel[,] [and ]QC Specialist personnel working for subcontractors[ and the Designer of Record]. The joint use of this system is to facilitate; electronic exchange of information, key processes, and overall management of the contract. WebCM shall be the primary means of project information submission and management. When required by the Contracting Officer, paper documents will also be provided (i.e.; e.g. the signature of Contract Modifications and submission of Contract Claims). In the event of discrepancy between the electronic version and paper documents, the paper documents will govern.

Primavera Project Planner, P3e/c, Primavera Project Manager, SureTrak and PrimeContract are registered trademarks of Primavera Systems, Inc. Microsoft, Internet Explorer, Outlook, Word, and Excel are registered trademarks of Microsoft Corporation in the U.S.A. Adobe and Acrobat are registered trademarks of Adobe Systems Incorporated.

1.2 USER ACCESS LIMITATIONS

**********
**NOTE: Include the bracketed phrase if the project will be Design Build.**
**********

The Contracting Officer will control the Contractor's access to WebCM by allowing access and assigning user profiles to accepted Contractor personnel. User profiles will define levels of access into the system; determine assigned function-based authorizations (determines what can be seen) and user privileges (determines what they can do). Sub-contractors and suppliers will not have direct access to WebCM. Entry of information exchanged and transferred between the Contractor and its [Designer of Record, ]sub-contractors and suppliers on WebCM shall be the responsibility of the Contractor.

1.2.1 Joint Ownership of Data

Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the WebCM system) by the Contracting Officer and the Contractor will be jointly owned.

1.3 AUTOMATED SYSTEM NOTIFICATION AND AUDIT LOG TRACKING

Review comments made (or lack thereof) by the Government on Contractor submitted documentation shall not relieve the Contractor from compliance with requirements of the Contract Documents. The Contractor is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents. Government acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Contractor's submitted information.

1.4 SUBMITTALS

**********
**NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary**

factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

**********

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

**********

NOTE: Use Section 01332N for Design-Build projects, replacing Section 01330 referenced above with Section 01332N.

**********

SD-01 Preconstruction Submittals

List of Contractor's key WebCM personnel.

Include descriptions of key personnel's roles and responsibilities for this project.

[1.5 COMPUTER REQUIREMENTS

The Contractor shall use computer hardware and software that meets the requirements of the WebCM system as recommended by Primavera Systems, Inc. to access and utilize WebCM. As recommendations are modified by Primavera, the Contractor will upgrade their system(s) to meet the recommendations or better. Upgrading of the Contractor's computer systems will not be

justification for a cost or time modification to the Contract.

]1.6 CONTRACTOR RESPONSIBILITY

The Contractor shall be responsible for the validity of their information placed in WebCM and for the abilities of their personnel. Accepted users shall be knowledgeable in the use of computers, including Internet Explorer, e-mail programs such as Outlook, word processing programs such as Word, spreadsheet programs such as Excel, and Adobe Portable Document Format (PDF) document distribution program. The Contractor shall utilize the existing forms in WebCM to the maximum extent possible. If a form does not exist in WebCM and the Contractor must include as an attachment or by uploading the data file, PDF documents will be created through electronic conversion rather than optically scanned. The Contractor is responsible for the training of their personnel in the use of WebCM and the other programs indicated above as needed. All costs associated with the use of this system will be evenly distributed in the project overheads and spread across the duration of the contract; a separate cost line item will not be allowed.

1.6.1 User Access Administration

**********

**NOTE: Include the first bracketed phrase if the project will be Design Build. Include the second bracketed phrase if the Specification Section 01450 requires the presence of QA Specialists.**

**********

Provide a list of Contractor's key WebCM personnel for the Contracting Officer's acceptance. Notify the Contracting Officer immediately of any users that are to have access removed. Resubmit the personnel list whenever modified. User changes will take effect within 1 one working day of accepting the requested change. The Contracting Officer reserves the right to perform a security check on all potential users. The Contractor will be allocated [5][__] key personnel with access to WebCM. Access will include [[2][__] key personnel from the Designer of Record][ and ][one access for each QC Specialist while they are performing their duties, per Section 01450N DESIGN AND CONSTRUCTION QUALITY CONTROL.].

1.7 CONNECTIVITY PROBLEMS

WebCM is a web-based environment and therefore subject to the inherent speed and connectivity problems of the Internet. The Contractor is responsible for its own connectivity to the Internet. WebCM response time is dependent on the Contractor's equipment, including processor speed, modem speed, Internet access speed, etc. and current traffic on the Internet. The Government will not be liable for any delays associated from the usage of WebCM including, but not limited to: slow response time, down time periods, connectivity problems, or loss of information. Under no circumstances shall the usage of the WebCM be grounds for a time extension or cost adjustment to the contract.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 WEBCM UTILIZATION

WebCM shall be utilized in connection with submittal preparation and information management required by Section 01321N NETWORK ANALYSIS SCHEDULES (NAS), Section 01330 SUBMITTAL PROCEDURES, Section 01450N DESIGN AND CONSTRUCTION QUALITY CONTROL and other Division One sections. Requirements of this section are in addition to requirements of all other sections of the specifications.

[

3.1.1 Design Document Submittals

**********
**NOTE: Include this paragraph if the project will be Design Build.**
**********

Provide all design drawings and specifications in file formats specified in other sections of the contract documents.

]3.1.2 Shop Drawings

Shop drawing and design data documents shall be submitted as PDF attachments to the WebCM submittal workflow process and form. All PDF shop drawing submittal documents shall have the Contractor's review and submittal stamp (including signatures) as specified in Section 01330 SUBMITTAL PROCEDURES the same as if submitted as hard copy. Examples of shop drawings include, but are not limited to:

a. Standard manufacturer installation drawings.

b. Drawings prepared to illustrate portions of the work designed or developed by the Contractor.

c. Steel fabrication, piece, and erection drawings.

3.1.3 Product Data

Product catalog data and manufacturers instructions shall be submitted as PDF attachments to the Webs submittal workflow process and form, except that color charts and similar color oriented pages shall be submitted as hard copy separate from and in addition to the PDF copy. Submittal forms shall indicate when hard copy color documents are submitted. All PDF product data submittal documents shall have the Contractors review and submittal stamp (including signatures) as specified in Section 01330, "Submittal Procedures" the same as if submitted as hard copy. Examples of product data include, but are not limited to:

a. Manufacturer's printed literature.

b. Preprinted product specification data and installation instructions.

3.1.4 Samples

Sample submittals shall be physically submitted as specified in Section 01330 SUBMITTAL PROCEDURES. Contractor shall enter submittal data information into WebCM with a copy of the transmittal form(s) attached to the submittal. Examples of samples include, but are not limited to:

a. Product finishes and color selection samples.

b. Product finishes and color verification samples.

c. Finish/color boards.

d. Physical samples of materials.

3.1.5 Administrative Submittals

All correspondence and Preconstruction submittals shall be submitted on WebCM. Examples of administrative submittals include, but are not limited to:

a. Digging permits and notices for excavation.

b. List of Contractor personnel accessing WebCM.

c. List of contact personnel.

d. Notices for roadway interruption, work outside regular hours, and utility cutovers.

e. Requests for Information (RFI).

f. Network Analysis Schedules and associated reports and updates. Each schedule submittal specified in Specification Section 01321N NETWORK ANALYSIS SCHEDULES (NAS) shall be submitted as a native backed-up file (.PRX or .STX) of the scheduling program being used. The schedule will also be posted as a PDF file in the format specified in Specification Section 01321N. Due to data transfer rates, do not display relationship lines in the graphical depiction of the schedule.

g. Submittal Register: Use the submittal register data provided by the Government. Contractor shall input data for dates as specified and upon acceptance of the register, load the register up to WebCM and update as required by the Contract documents.

h. Plans for safety, demolition, environmental protection, and similar activities.

i. Quality Control Plan(s), Testing Plan and Log, Quality Control Reports, Production Reports, Quality Control Specialist Reports, Preparatory Phase Checklist, Initial Phase Checklist, Field Test reports, Summary reports, Rework Items List, etc.

**********

**NOTE: Include the bracketed phrase if the project will be Design Build.**

**********

j. Meeting minutes for [Post Award Kick-off Meeting, design review meetings, ]quality control meetings, progress meetings, pre-installation meetings, etc.

k. Any general correspondence submitted.

3.1.6 Compliance Submittals

Test report, certificate, and manufacture field report submittals shall be submitted on WebCM as PDF attachments. Examples of compliance submittals include, but are not limited to:

a. Field test reports.

b. Quality Control certifications.

c. Manufacturers documentation and certifications for quality of products and materials provided.

3.1.7 Record and Closeout Submittals

Operation and maintenance data and closeout submittals shall be submitted on WebCM as PDF documents during the approval and review stage as specified, with actual set of documents submitted for final. Examples of record submittals include, but are not limited to:

a. Operation and Maintenance Manuals: Final documents shall be submitted as specified.

b. As-built Drawings: Final documents shall be submitted as specified.

c. Extra Materials, Spare Stock, etc.: Submittal forms shall indicate when actual materials are submitted.

3.1.8 Exceptions

Documents with legal consequences, contract modifications, contract claims, security implications, and those required by other agencies may require an additional submittal as original hard copy with original signatures and seals. Hard copies of these documents shall be submitted as specified or as directed by the Contracting Officer.

-- End of Section --